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Course Code: 08P401

Roll No:

(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, APRIL / MAY - 2012

BE / BE(SW) - PRODUCTION ENGINEERING

Semester: 4

08P401 FLUID MECHANICS AND MACHINERY

Time: 3 Hours

Maximum Marks: 100

INSTRUCTIONS:

1. Group I and Group II questions should be answered in the Main Answer Book.
2. Answer any **FIVE** questions in Group II.
3. Answer **ALL** questions in Group I and Group III.
4. Group III – **Multiple Choice questions** - (which will be given to the candidates half an hour before the scheduled close of the examination) should be answered only in the space provided in the Main Answer Book.
5. Moody's Chart, Fluid properties table and Minor loss coefficient tables is to be brought by the candidate in the exam hall.

GROUP I

Marks: 10 x 3 = 30

1. Differentiate dilatants from pseudo-plastic fluids.
2. Show that the stream function is constant for a given streamline.
3. State Reynolds transport theorem.
4. What is the condition of incomplete similarity in model testing?
5. Give a condition where the minor losses could be higher than the frictional losses in a piping system.
6. Why are liquid drops spherical in shape?
7. What is the use of draft tubes in turbines?
8. What is the need for experimentation in fluid dynamics?
9. What is the effect of the variation of Reynolds number of flow on boundary layer thickness? Justify the answer.
10. Draw the characteristic and system curves of a pump and define the significance of the operating point.

GROUP II

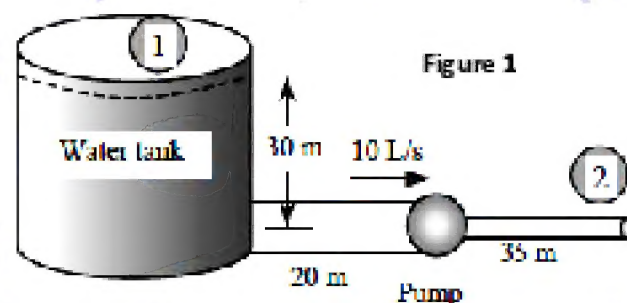
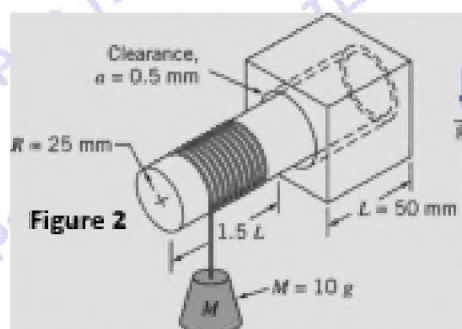
Marks: 5 x 12 = 60

11. The penstock supplies water from a reservoir to the Pelton wheel with a gross head of 500 m. One-third of the gross head is lost in friction in the penstock. The rate of flow through the nozzle is $2 \text{ m}^3/\text{s}$. The angle of deflection of the jet is 165° . Determine the

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- power supplied to the runner and hydraulic efficiency of the wheel. Speed ratio = 0.45 and $C_v = 1.0$.
12. Using control volume approach derive the momentum integral equation of a boundary layer flow and hence derive the momentum integral equation of a flat plate boundary layer.
 13. Derive the Navier-Stokes equation for a steady incompressible flow.
 14. Water at 15°C is to be discharged from a reservoir at a rate of 18 L/s using two horizontal cast iron pipes connected in series and a pump between them as shown in figure 1. The first pipe is 20 m long and has a 6 cm diameter, while the same for the second pipe are 35 m and 4 cm respectively. The pipe entrance is sharp edged and losses associated with the connection of the pump are negligible. Neglecting the kinetic energy correction factor, determine the required pumping head and the minimum pumping power to maintain the indicated flow rate.
 15. The drag force on a torpedo is found to depend on the diameter, velocity, density and viscosity. A one-fifth scale model of a torpedo is tested in a wind tunnel to determine the drag force. The prototype operates in water, has 533 mm diameter and is 6.7 m long. The desired operating speed of the prototype is 28 m/s . To avoid compressibility effects in the wind tunnel, the maximum speed is limited to 110 m/s . However, the pressure in the wind tunnel can be varied while holding the temperature constant at 20°C . At what minimum pressure should the wind tunnel be operated to achieve a dynamically similar test? Evaluate the drag force on the prototype if the model drag is measured as 618 N . (Gas constant of air $R = 287 \text{ J/kg.K}$).
 16. A circular aluminum shaft ($\rho = 2700 \text{ kg/m}^3$) mounted in a journal is shown in figure 2. The symmetric clearance gap between the shaft and journal is filled with SAE 10W-30 oil ($\mu = 0.1 \text{ Ns/m}^2$) at 30°C . The shaft is caused to turn by the attached mass and cord. Develop and solve a differential equation for the angular speed of the shaft as a function of time. Calculate the maximum angular speed of the shaft and the time required to reach 95% of this speed.



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Write the Alphabet of your choice answer for each question in the space provided in the Main Answer Book

(Do not attach this question paper along with the Main Answer Book)

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GROUP III

Marks: 10 x 1 = 10

- I) Flow occurring in a pipe line when a valve is being opened is
 A) unsteady B) steady C) laminar D) vortex
- II) The fluid forces considered in the Navier-Stokes equation are
 A) gravity, pressure and turbulent B) pressure, viscous and turbulent
 C) gravity, pressure and viscous D) gravity, viscous and turbulent
- III) A computer cooling fan is a
 A) ducted fan B) radial fan C) centrifugal fan D) centripetal fan
- IV) Hydraulic grade line for any flow system as compared to energy line is
 A) uncertain B) above C) below D) at same level
- V) The modern Francis turbine is a _____ flow type of reaction turbine
 A) mixed B) axial C) reversible D) irreversible
- VI) Draft tubes are provided only in
 A) Francis turbine B) reaction turbine
 C) impulse turbine D) Kaplan turbine
- VII) A is a gas pump designed to deliver a very high pressure rise, typically at low to moderate flow rates.
 A) propeller B) fans C) blower D) compressor
- VIII) For internal flow in a circular pipe the generally accepted value of the critical Reynolds number is
 A) 800 B) 2300 C) 7000 D) 2430
- IX) The pumping power requirement for a laminar flow piping system can be reduced by a factor of ____ by doubling the pipe diameter
 A) 1 B) 23 C) 6 D) 16
- X) Viscosity of a fluid with specific gravity 1.3 is measured to be 0.0034 Ns/m^2 . Its kinematic viscosity in m^2/s is
 A) 4.4×10^{-6} B) 2.6×10^{-6} C) 7.2×10^{-6} D) 5.8×10^{-6}